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(54) Title of the invention: GLOBULIN-CONTAINING FEED

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SPECIFICATION

1. TITLE OF THE INVENTION

GLOBULIN-CONTAINING FEED

2. SCOPE OF PATENT CLAIMS

(1) Pig feed that contains antibacterial agents that are effective against bacteria and a substance containing globulins that is obtained from animal blood or milk.

(2) The pig feed described in Claim 1 of the scope of patent claims, wherein the globulin-containing substance is blood plasma or blood serum derived from pig blood, or milk serum derived from the milk of a cow, or the above substances after processing.

(3) The pig feed described in Claim 1 of the scope of patent claims, wherein the antibacterial agent contains a combination of one type of antibiotic agent that is effective against Gram positive bacteria and one type of antibiotic agent or synthetic antibacterial agent that is effective against gram negative bacteria.

3. DETAILED DESCRIPTION OF THE INVENTION

(TECHNICAL FIELDS OF USE OF THE INVENTION)

The present invention pertains to pig feed that contains blood plasma, blood serum or milk serum that are obtained from the blood serum or milk of animals, where these contain immunologically active globulins, or a processed material [said the blood plasma, blood serum or milk serum], as well as an antibacterial agent that is effective against bacteria, them and the purpose of the invention is to provide a pig feed that is extremely effective in the healthy rearing of young animals.

(PRIOR ART)

It is known that generally, while young, animals are normally more susceptible to infection from bacterial pathogens in their environment during, for example, the first one to three weeks of life, in the case of piglets, and this can result in a large number of cases of diarrhea, which leads to delayed growth. These and other serious losses are well known. Currently, synthetic antibacterial agents or antibiotic agents are used in the treatment or prevention of such diarrhea, but it is not always possible to obtain sufficient effect. In order to solve such problems, attempts have been made in recent years to prevent the occurrence of diarrhea by orally administering synthetic milk, to which the immunoglobulins contained in bovine colostrum have been added, to animals during their nursing period. (Japanese Unexamined Patent Application Publication S56-124352 and Japanese Unexamined Patent Application Publication S58-76052). Furthermore, it is known that immunoglobulins derived from animal blood serum are also effective in preventing diarrhea in young nursing animals. (Japanese Examined Patent Application Publication S46-43899, Japanese Examined Patent Application Publication S48-35201, Japanese Unexamined Patent Application Publication S52-25018, Japanese Unexamined Patent Application Publication S54-119019 and Japanese Unexamined Patent Application Publication S55-4304).

(PROBLEM TO BE SOLVED BY THE INVENTION)

There were limits to the amounts and the supply source of the former bovine colostrum while with the latter, the blood serum immunoglobulins, these were obtained by exposing pathogens in large amounts to horses, cows, pigs, goats, sheep and various other animals, and after sufficient antibody titer had been reached, blood samples were drawn and blood serum or immunoglobulins were extracted [to obtain said immunoglobulins]. Thus, the process was complicated and expensive, with significant cost requirements, and in all cases, it was difficult to obtain large amounts.

(EFFECTS AND MEANS FOR SOLVING THE PROBLEMS)

The inventors discovered that supplying young piglets with mixed feed that contains both an antibacterial agent normally used in livestock feed and substances containing globulins that can be obtained in large quantities such as milk serum derived from normal cows' milk or blood plasma or blood serum that can be easily harvested from pig blood produced at slaughterhouses had the effect of producing a marked increase in weight and improved feed efficiency, and they propose here a new feed for raising pigs.

To explain the present invention in greater detail, the animal blood that serves as the raw material is not limited to a particular type of livestock, and blood that can be easily supplied and obtained at beef, pork or other types of slaughterhouses, especially pig blood, which can be obtained in large quantities, is desirable. When harvesting this blood, an anti-clotting agent, such as citric salt, is added in a suitable amount, and next, the sample is centrifuged while taking care not to destroy the red blood cells, to obtain the supernatant fraction, that is, the blood serum. Also, if necessary, the blood serum could be obtained by filtering out insolubles like fibrin that elute out. Then, after adding a suitable amount of non-fat milk powder or lactose to the blood plasma or blood serum, lactic acid bacteria is placed in it to cause fermentation, resulting in a fermented product. This processed product contains gamma globulins, in the amount of approximately 1 to 4% as a solution or 20 to 30% in a dry format, which exhibit an antibody effect on pathogenic E. coli derived from pigs or cows found in the blood plasma, blood serum or processed products thereof. Needless to say, gamma globulins can be obtained from the above raw materials using known methods such as salting-out methods or alcohol precipitation methods to produce purified gamma globulins, but with the present invention, we use simple operations to prepare crude gamma globulins. Additionally, well-known bovine colostrum could also be listed as the globulin raw material, and in the present invention, we use bovine milk (in particular, milk serum) that contains lactoglobulin. This sort of milk serum is obtained by separating the casein and the fat from normal cow milk, and the globulin (as lactoglobulin) content is 0.1 to 0.2% or more and, in addition to the milk serum itself, other substances that are used as globulin-containing substances include the impurities in the milk serum, such as lactose, other low molecular organic or inorganic substances, where these have been removed with a well-known method. The sorts of globulin-containing substances described above may either be in a liquid state or a powder state, freeze dried using known methods, and these are added directly to feed or else premixed separately with part of the raw materials of the feed and then mixed into the feed. The globulin concentration in the feed is kept extremely low only when used with the antibacterial agents described below, with sufficient effect observed at levels of approximately 10 to 1,000 ppm in nursing piglets from birth through weaning age and then approximately 1 to 200 ppm from weaning age through three months, for example.

Meanwhile, antibacterial agents that could be mixed into the feed in the present invention include antibiotics for animal feed or synthetic antibacterial agents in general conventional use, such as bacitracin, virginiamycin, enramycin, thiopeptin, colistin, bicozamycin, tylocin, 2-methyl-3-(β-hydroxy methyl carbamoyl) quinoxaline-1,4-di-N-oxide, etc. These antibacterial agents are available already mixed into commercial feed and they can be used individually or one type of antibacterial agent that is effective against Gram positive bacteria may be combined suitably with one type of antibacterial agent that is effective against Gram negative bacteria, and it is preferable that the mixture contain a combination of two or more types. Additionally, the amount of those antibacterial agents in the feed should be as follows: for antibiotics effective against Gram positive bacteria such as bacitracin: 40 to 100 ppm, enramycin: 2.5 to 20 ppm, virginiamycin: 10 to 20 ppm, thiopeptin: 1 to 20 ppm and for those effective against Gram negative bacteria like colistin: 2 to 40 ppm (Gram titer), bicozamycin: 5 to 20 ppm (Gram titer), tylocin: 22 to 88 ppm and quinoxaline-1,4-di-

N-oxide derivatives: 10 to 50 ppm. There are no particular limits on the types of pig feed of the present invention and it would be possible to use it in, for example, the nourishing milk supplied to nursing young animals, normal synthetic milk or mixed feed that is supplied from around the time of weaning, etc.

When pig feed that is made up of substances containing globulins derived from animal blood fluids like those described above or substances containing globulins derived from bovine milk, and antibacterial agents that are effective against bacteria, is given to nursing piglets, we observe a 5 to 20% or greater increase in body growth than in groups given normal feed, to which no additives with globulins are added and only antibacterial agents have been added, and there is a marked improvement in feed efficiency, and these are very advantageous to the livestock industry.

Below, we will explain embodiments of the present invention more specifically.

(EMBODIMENT 1)

Blood harvested from a slaughterhouse is centrifuged and the blood plasma (supernatant fraction) is retrieved. We measured the gamma globulins in this blood plasma using normal immuno-diffusion methods and found it to be 2.08%. We took part of this plasma and added 0.5% calcium chloride to elute the fibrin, which we separated to obtain the blood serum (supernatant fraction). This blood serum contained 2.20% gamma globulins. We then took part of this blood serum and, after adding 8% (weight/volume) of a commercially available fat-free powder milk, we added a lactic acid bacteria (Stretococcus lactis) and kept it at 30°C for 48 hours, fermenting it until the pH was 5.5 or less, to prepare the processed blood serum. The gamma globulin content of this processed serum was 2.10%. The above globulin-containing substances were homogenized and spray dried and then, added to the mixed feed artificial milk for nursing piglets shown in Table 1, to make 0, 10 mg (10 ppm) and 30 mg (30 ppm) of gamma globulin per kg of feed, and this feed was given to piglets that were 34 days old and we observed the results. The piglets were LWD pigs and there were seven in each group, weighing an average of 8.8 to 9.0 kg initially at the start of testing and they were fed for two to three weeks, with the average body weight increases and the feed demand rate calculated after two and then three weeks.

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Table 1 Artificial Milk

Ingredient	Ratio
Crude protein	18.0% or more
Crude fat	3.0 "
Crude fiber	3.5% or less
Crude ash	7.0 "
Calcium	0.6% or more
Phosphorus	0.45% "
Total digestible nutrients	8.05 "
Digestible crude protein	16.0 "
Insecticide (destomycin A)	8 ppm
Bacitracin	100 "
Colistin	40 "

Note also that the feed demand rate expressed the amount of feed consumed in relation to a specific amount of weight increase during the testing period in question, and this was calculated using the following formula

Feed demand rate = amount of feed consumed/amount of weight increase

Crude gamma globulin type		Amount of gamma globulins in feed	First two weeks		First three weeks	
			Increase in body weight	Feed demand rate	Increase in body weight	Feed demand rate
Control	No additives	(ppm) 0	(kg) 4.30 (100)	1.79 (100)	(kg) 7.90 (100)	1.76 (100)
The Present Invention	Blood plasma	10	5.28 (122.8)	1.66 (92.7)	9.06 (114.7)	1.68 (95.5)
		30	5.40 (125.6)	1.56 (87.2)	9.42 (119.2)	1.64 (93.4)
	Blood serum	10	5.55 (129.1)	1.61 (89.9)	9.84 (124.6)	1.67 (94.9)
		30	5.49 (127.7)	1.50 (83.8)	9.32 (118.0)	1.63 (92.6)
	Fermented lactic acid	10	5.20 (120.9)	1.60 (89.4)	9.00 (113.9)	1.66 (94.3)
		30	5.38 (125.1)	1.58 (88.3)	9.32 (118.0)	1.68 (95.5)

*Figures in parentheses in the table indicate an index where the control group is 100.

As a result, as shown in Table 2, by giving them feed containing crude gamma globulins, we observed remarkably good increases in body weight and the feed efficiency of the piglets.

(EMBODIMENT 2)

We separated the milk fat and casein from milk using normal methods and used what remained as a milk serum. Analysis of the lactoglobulins in this milk serum using the well-known method of high-speed liquid chromatography indicated 0.16% content. Next, we concentrated this milk serum using an ultra-filtration device, pushing the globulin concentration up to 1.80%. Note also that the filtration membrane that we used was a polysulfone copolymer with a molecular mass cut off of 13,000 and, with this concentration process, the lactose and inorganic matter were removed through permeation. We freeze-dried the concentrated milk serum that we obtained in this way and mixed it with a composition of the synthetic milk shown in Table 1, however, with the antibacterial agents (bacitracin and colistin) removed, such that the concentration of lactoglobulin fell within the range of 0 to 100 ppm and then, in order to observe the combined effect of each of the antibacterial agents, we ran breeding tests under the same conditions as in Embodiment 1 with the exception that the piglets were 32 days old. Those results are as shown in Table 3, and we observed better results when they were given feed containing globulins and antibacterial agents than when they were given feed containing antibacterial agents alone.

Table 3 Test Results

	Antibacterial Agent		Average weight at start	First two weeks	
	Type	Concentration		Increase in body weight	Feed demand rate
Control	Virginiamycin * Quinoxaline derivative	(ppm) 20 50	(kg) 7.92	(kg) 4.20	1.72
The present invention (Lacto-globulin added)	Virginiamycin Colistin	20 40	7.86	4.92	1.58
	Bacitracin * Quinoxaline derivative	100 50	7.81	4.80	1.62
	Thiopeptin Colistin	10 40	7.95	5.04	1.56

*2-Methyl-3-(β-hydroxymethyl carbamoyl) quinoxaline-1,4-di-N-oxide

(EMBODIMENT 3)

We added the blood plasma (gamma-globulin concentration of 2.08%) obtained in Embodiment 1 above to the composition shown in Table 4 at a mixing ratio of 1:1 (volume/weight)

Table 4

Name of Raw Material	Content (%)
Nonfat milk powder	46
Powdered fat	9
Soy protein powder	18
Gluctose	18
Minerals, vitamin mixtures (commercial premixes)	4.5

and, after homogenization, we dried it using a spray dryer, yielding raw material for feed with a gamma globulin content of 2.0%. Next, we mixed this raw material for feed with the composition of synthetic milk for raising nursing piglets shown in Table 1 above, however, from which the antibacterial agents (bacitracin and colistin) had been removed, such that the ratio of feed was 0.15% (gamma globulin content of 30 ppm) and then, in order to observe the effect when the various antibacterial agents were added, we ran our breeding test on piglets that were 25 days old. The piglets were cared for under the same conditions as Embodiment 1, with the exception that the average initial weight of the piglets was 6.17 to 6.42 kg. Those results are as shown in Table 5, and the combined addition of bacitracin and virginiamycin or other antibiotics effective against Gram positive bacteria with colistin or other antibiotic substances effective against Gram negative bacteria to the feed containing gamma globulins led to a marked improvement in the average body weight gain and the feed demand rate of the piglets.

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Table 5

	Antibacterial Agent		Average body weight at start	First two weeks		First three weeks	
	Type	Amount added		Increase in body weight	Feed demand rate	Increase in body weight	Feed demand rate
Control		(ppm)	(kg)	(kg)		(kg)	
	No additives	0	8.31	4.15	1.72	7.13	1.79
	Bacitracin	100	6.42	4.48	1.63	7.49	1.73
	Colistin	40	6.17	4.77	1.58	8.06	1.61
The Present Invention	Bacitracin Colistin	100 40	6.38	5.31	1.48	8.84	1.57
	Virginiamycin Colistin	20 40	6.29	5.10	1.51	8.49	1.60

Note: The gamma globulin content of the feed in all test areas was 30 ppm.

(EFFECT OF THE INVENTION)

As explained above, when the globulin-containing feed of the present invention, in other words, the mixture of raw material for synthetic milk with a globulin-containing substance such as blood plasma or blood serum obtained easily from animal blood, especially that of pigs, or lactic acid-fermented products thereof, or milk serum obtained from cow milk, wherein this mixture further contains one type or preferably two types of normal, feed-use antibacterial agents, is supplied to young-age piglets as a synthetic milk for nursing age piglets, a remarkable weight-gain promoting effect and an improved effect in the feed effect are obtained.

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